



Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at <http://about.jstor.org/participate-jstor/individuals/early-journal-content>.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

TORREYA

July, 1905

AN EXAMPLE OF COMPLEX LIFE-RELATIONSHIP

BY ALBERT SCHNEIDER

The plant as well as the animal kingdom presents numerous very interesting and complex life-relationships which the biologist recognizes as symbioses, the naturalist as struggle for existence, and the socialist, if he is scientifically inclined, as competition.

A somewhat remarkable instance of symbiosis has recently come under my observation. During the vacation months (May, June, and early July) of 1904, my little daughter and myself were in the habit of taking short morning rambles in the vicinity of our Berkeley home. On Hillegass Avenue near Dwight Way, we noted a row of hawthorns (*Crataegus Oxyacantha*), about twelve feet high. Most of the plants were well infested with plant-lice (*Aphis Crataegi*) at this time of the year (June). These pests were found most abundant on the under surface of the leaves and on the young terminal branches and buds, and wherever the bark was unusually thin, injured or abraided; that is, in places where the cell sap was most readily obtainable. Upon closer examination, it was found that some of the plant-lice were of a black color, due to a fungus attacking them. The remarkable feature was that the parasitized plant-lice seemed, at first, to be quite uniformly distributed among the green healthy individuals. Gradually the fungus disease spread, until perhaps one-third to one-half of all the plant-lice on one particular hawthorn were blackened, but not dead. Many were no doubt killed and fell to the ground. A thin scattering stream of ants (the honey ant, *Myrmicocystis melliger*) was continuously moving up and down the trunk and branches of the hawthorns. The ants visited the *Aphis* and took from them the sweet secretion (honeydew) found in the posterior glands. Occasionally an ant

[No. 6, Vol. 5, of TORREYA, comprising pages 99-118, was issued June 24, 1905.]

was seen carrying a plant-louse, usually a young one, down the trunk. What the fate of these plant-lice was we were unable to determine. Perhaps they were intended to serve the purpose of starting new colonies on other plants but more likely they were taken to the home of the ants to serve as food, for ants feed on plant-lice when the appetite is upon them, just as man keeps cows both for milk and meat. I am, however, inclined to doubt the statements of many naturalists who speak of the carefully conducted hygienic aphid-dairying industries of ants. In countries with suitable climatic conditions, as, for example, California, aphides are very plentiful and widely distributed upon a great variety of plants, and ants cannot well avoid running across them on hawthorns, roses, chenopodiums, thistles, plum-trees and a host of other plants.

The starting of new colonies of *Aphis* seems wholly unnecessary, yet who is there to know all of the factors concerned in the ant commercial competition? Be that as it may, the ant is not the only organism that finds the *Aphis* an available economic victim. We noted several species of beetle of the ladybird variety, quite numerous and quite constantly present in the grass (*Poa*) and on other plants near the infested hawthorns. The brown-winged ladybird (*Hippodamia convergens*) was found to feed very voraciously upon the plant-lice. It was roughly conjectured that one ladybird would destroy (feed upon) its own weight of plant-lice in the course of one night. Some of these handsome little beetles were found basking in the morning sun, evidently digesting a heavy meal. Others were busily engaged with their breakfast. This ladybird promises to be of economic value in the extermination of plant-lice. A report on its possible uses is about to be published by the Dept. of Agriculture of the University of California. Another beetle (dark green elytra with black spots) (*Diabrotica Soror*) was also quite constantly present and seemed to feed upon *Aphis*, although it also feeds upon the black fungus on the hawthorn and the diseased plant-lice above referred to. A lightning bug (*Podabrus pruni-asus*) is also an occasional visitor and feeds upon plant-lice. The ants and beetles pay no attention to each other, evidently because they realize the fact that they are incapable of harming each other.

A species of yellow-jacket (*Vespa*) visits the hawthorn for the purpose of securing plant-lice for its larvae. Various species of flies (Diptera) were found to visit the plant-lice to take from them the sweet honeydew and these winged aerial marauders take care to keep out of reach of the ants, which they are readily enabled to do. Another and larger species of ant was occasionally found on the hawthorn. While it was quite evident that it was also in quest of the honeydew of the *Aphis*, it was equally evident that it was mortally afraid of the smaller but decidedly more pugnacious honey-ant, making every effort to keep out of the way.

Another ladybird (*Coxinella californica*) also feeds upon the *Aphis*, but is much less voracious in its appetite than the *Hippodamia*. The ladybirds were however not sufficiently numerous to destroy all of the aphides which multiply so rapidly that there seemed to be no diminution in their number, in spite of these numerous life-destroying enemies. Later in the season (the latter part of July and the early part of August), the *Aphis* began to disappear gradually so that practically none remained by the middle of September. This sporadic and often sudden disappearance of *Aphis* has been noted frequently but is not as yet satisfactorily explained. The natural enemies as ladybirds and the fungus referred to are evidently not the only factors concerned in these disappearances. Various birds, as sparrows and others, are often seen to feed upon the *Aphis*, scooping them up in large numbers by a peculiar side twist of the bill.

A black fungus lives upon the leaves, leaf-stalks and younger branches of the hawthorns, causing them to become unsightly in appearance, although no serious damage is done. It is very evident that the plant-lice are the cause of this fungous investment as the growth starts in the *Aphis* and then spreads over the plant. Besides this fungus, there are other vegetable symbionts, as various algae, bacteria and other fungi, which, however, have no apparent influence upon the life history of the host plant (hawthorn). The various more serious diseases of the hawthorn, due to fungi and insects, are not touched upon in this paper as this would further complicate the biological relationship and

furthermore constitutes a condition essentially different from that discussed in this paper.

This interesting symbiosis or biological relationship may be summarized as follows :

1. The bone of contention seems to be the plant-lice (*Aphis Crataegi*) which are antagonistically associated with the hawthorn (*Crataegus Oxyacantha*), feeding upon the cell sap of leaves, growing tips and injured or thin portions of the young bark.

2. A hyphal fungus infests the plant-lice, destroying many of them and finally spreading over the exterior of leaf and stem of the hawthorn. The fungus is therefore decidedly antagonistic to the *Aphis* and rather indifferently antagonistic to the hawthorn.

3. Two species of ant, antagonistic to each other and mutualistic to the hawthorn, feed upon the honeydew of the *Aphis* and upon the *Aphis* itself and are therefore antagonistic to these organisms.

4. Several species of beetles, indifferently associated with each other but mutualistically associated with the hawthorn, feed upon the *Aphis*, forming therefore a decided antagonism to the *Aphis*.

5. One species of ladybird (*Diabrotica Soror*) feeds upon the fungus and diseased *Aphis*, thus forming a mutualistic (though perhaps not pronounced) association with both *Aphis* and hawthorn.

6. The yellow-jacket feeds upon the *Aphis* thus forming an antagonistic association with these as well as with the ants, but mutualistic with hawthorn.

7. A similar association exists between birds, *Aphis*, ants and hawthorn.

8. Flies are antagonistic to the interest of ants as well as *Aphis* and mutualistic to the hawthorn itself.

From this maze of complicated biological relationship it would appear that the plant-lice must be at a decided disadvantage in the struggle for existence, since it is very evident that they have numerous enemies and apparently no true friends. Furthermore, as compared with these enemies they are physically helpless, being mostly wingless, slow of motion and without means of offense or defense. These deficiencies are however

more than balanced by their rapid propagation. In spite of the numerous aids and friends of the hawthorn, the combined work of the *Aphis* and the black fungus succeed in making the plants quite unsightly during the summer months, though none are actually killed.

In conclusion it may be stated that plant-lice are quite easily controlled by spraying and fumigation, directions for which may be obtained from almost any state experiment station or from the Dept. of Agriculture, Washington, D. C. The behavior of the black fungus would suggest a cure by distributing the diseased *Aphis* among the infested plants; or if large numbers of diseased *Aphis* are available, they might be crushed and mixed with water to be applied as a spray, thus spreading the disease more quickly and uniformly. This method would seem especially feasible during a rainy period as moisture favors the spreading of the disease, whereas dry weather promptly checks it. This is certainly worthy a trial and further study. It will also be interesting to find what the California Agricultural College may recommend in regard to the possibilities with the ladybird beetles.

CALIFORNIA COLLEGE OF PHARMACY, SAN FRANCISCO.

QUELQUES MOTS SUR L'ARTICLE DE MR. UNDERWOOD: "A MUCH-NAMED FERN"

BY H. CHRIST

Dans le no. 5, vol. 5 (Mai 1905) de TORREYA, Mr. Lucien Underwood relève le fait, regrettable sans doute, que j'ai rebaptisé une petite fougère, nommée d'abord *Acrostichum Moorei* E. G. Britton, sans connaître son nom primitif, et que j'ai changé plus tard mon nom à plusieurs reprises. Avec la verve critique qui lui est propre, il se récrie: "And all this is German systematic (?) botany of the twentieth century instead of the nineteenth, where it would not so much surprise us."

Je me hâte de revendiquer ce compliment exquis pour moi exclusivement, pour moi qui ne suis point Germain, mais humble Suisse, absolument neutre dans la lutte acharnée des grandes nations qui s'infilte partout, même dans la Science aimable!